# ESTIMATES OF HYDRAULIC CONDUCTIVITIES ALONG THE RUSSIAN RIVER USING GROUNDWATER TEMPERATURE PROFILES

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## RESEARCH OBJECTIVES

Quantifying surface-groundwater exchanges has become an important component of water resources management, resulting from the increase in the conjunctive use of water resources. Reducing uncertainty in models used to select optimal operation management alternatives requires proper identification of the spatial and temporal variations in physical parameters, such as the hydraulic conductivity.

Recently, heat as a tracer has been demonstrated to be a robust method for quantifying surface-groundwater exchanges. Groundwater temperatures and water levels are routinely monitored in observation wells near streams, but temperature data are generally considered a water-quality parameter and are not used as an environmental tracer to characterize hydraulic parameters. The objective of this study is to quantify the spatial and temporal variations of the alluvial aquifer hydraulic conductivites along the middle reaches of the Russian River in Sonoma County, California, by analyzing groundwater temperature profiles and water levels measured in six observation wells.

## APPROACH

Stream temperatures, groundwater temperatures, and well water levels recorded from June 2000 through October 2000 were used to develop two-dimensional groundwater flow and heat transport simulations of the region from the river to each observation well. Different values for the hydraulic conductivity were used in the simulations, and the value resulting in the smallest difference between the simulated and observed temperatures was considered the best estimate. Simulations were performed under isotropic conditions and with anisotropy (horizontal-to-vertical hydraulic conductivity) values of 2 and 5.

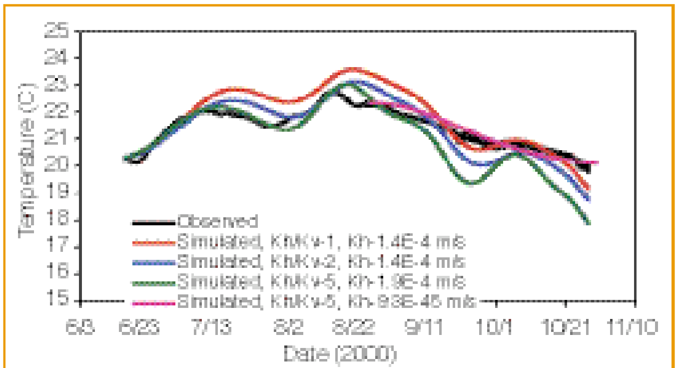


Figure 1. Groundwater temperatures recorded between June and October 2000 in an observation well close to a dam and the best fit simulated temperature profiles at different anisotropies (Kh/Kv). After mid-August, a smaller conductivity is necessary to obtain a good fit.

## ACCOMPLISHMENTS

Estimated hydraulic conductivities varied by almost two orders of magnitude over the six locations analyzed, from $1.7 \times 10^{-5}$ m/s to $2.3 \times 10^{-3}$ m/s. The simulated temperature profiles generally fit the observed ones best when an anisotropy of 5 was used. In some locations, a change in the observed temperature profile occurred through the summer and fall, most likely caused by deposition of fine-grained sediment and organic matter plugging the streambed. A reasonable fit to this change in the temperature profile was obtained by decreasing the hydraulic conductivity in the simulations. The most significant decrease in conductivity occurred in the region closest to an inflatable dam, where the conductivity decreased by about one-half after mid-August, as shown in Figure 1.

## SIGNIFICANCE OF FINDINGS

The results of this study demonstrate that groundwater temperatures and water levels monitored in observation wells can provide an effective means of estimating alluvial aquifer hydraulic conductivities. The temporal and spatial estimates in hydraulic conductivities will be incorporated into a three-dimensional groundwater model of this study area currently under development.

## RELATED PUBLICATION

Su, G.,W., J. Jasperse, D. Seymour, and J. Constantz, Analysis of water levels and temperatures in wells to estimate alluvial aquifer hydraulic conductivities. Ground Water, 2003 (submitted).

## ACKNOWLEDGMENTS

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